

Electrochemical deposition of Ni-Cr alloys from ethylene- and propylene glycol solutions

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Protective and functional nickel coatings owing to their high wear, heat and corrosion resistance are demanded in different industry's branches such as electronics, instrumentation, production of household appliances and furniture. The growing demands to the production quality cause the necessity to improve coatings properties. It could be done by the substitution of individual metals by their alloys. Nickel–chromium alloys are of great interest because of their hardness, wear resistance, corrosion stability and high heat resistance that is realized at a certain ratio of nickel and chromium in coatings. These alloys are used as finishing or intermediate coatings in steel molds and in different implements.

Aqueous Cr(III) и Ni(II) containing solutions are known to be used for electrochemical deposition of nickel–chromium alloys. However, they are not widespread because of the difficulties in maintenance the demanded alloy composition that is due to the instability of electrolyte in the result of hydrolysis and hydration isomerism of Cr(III) compounds.

The way to prevent the hydrolysis and hydration isomerism is to use nonaqueous polar solvents instead of water solutions for Ni–Cr alloy electroplating. Polyatomic alcohols such as ethylene glycol (EG), propylene glycol (PG), glycerin can be used as the solvents. Their advantages consist in the alteration of electrode potentials and overvoltages of metal ions reduction, in prevention of the hydrolysis. As a result, the processes of passivation of electrodes with hydroxides and hydrogen evolving are excluded and besides, coatings with low porosity are deposited [1, 2]

The purpose of this work was the investigation of nickel-chromium alloy electrochemical deposition from nonaqueous electrolytes with the usage of EG and PG as the solvents.

NiCl₂·6H₂O и CrCl₃·6H₂O were used as chromium and nickel precursors. Ni(II) : Cr(III) ratio was varied in the range of 1 : 1, 2 : 1, 1 : 2. Boric acid and ammonium chloride were used to increase the electroconductivity of the solution and to diminish its viscosity, as it was recommended in the work [3].

It was revealed that Ni–Cr coatings with reproducible composition were deposited from EG and PG electrolytes containing boric acid under Ni(II) : Cr(III) ratio equal to 1 : 1 with the rate of 3.7 or 3.9 μm/h. Chromium content in these coatings was varied in the limits 2–8 at.% in case of PG and EG electrolytes accordingly. The dependence of chromium content in the alloy from current density appeared to be nonlinear and maximal chromium quota was achieved at the current density 7.5 mA/cm². A slight dependence of chromium content on Cr(III) concentration and Ni(II) : Cr(III) ratio has been found.

Metals yield at this current density were equal to 21.4 % for nickel and 1.9 % for chromium in case of EG electrolyte and to 48.5 % for nickel and 0.6 % for chromium in case of PG solutions.

References

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Electrochemical activity of immobilized enzyme preparation of black horseradish on inorganic carries

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The influence of the inorganic carries (kaolin, aerosil, bentonite and its modified form on the electrochemical properties of black horseradish enzyme was studied using electrochemical impedance spectroscopy (Fig).

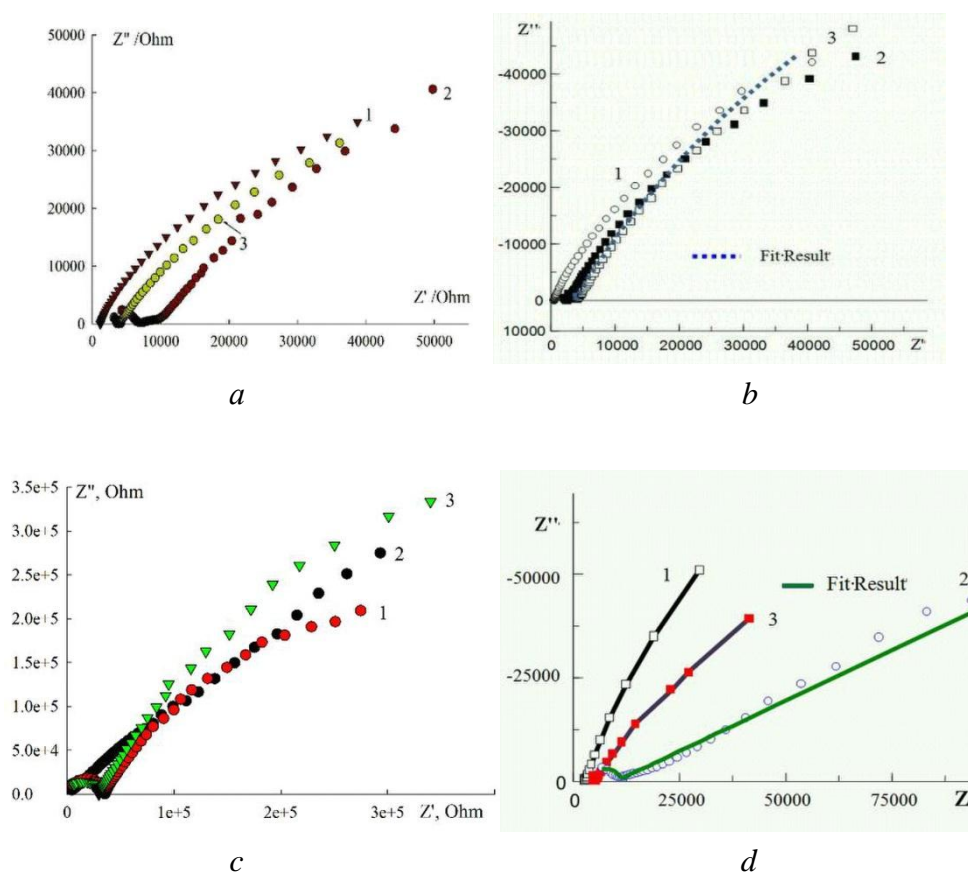


Fig. Impedance images of 0.5 % peroxidase solution, immobilized on bentonite (a), kaolin (b), modified bentonite (c), aerosil – 300 (d):
 1 – initial carrier, 2 – native material with the adsorbed peroxidase,
 3 – after 3 days in water

It was shown that strong proton-conducting properties of the substrate accelerate the conversion of proton-donor substrate and electron-conducting properties affect the conversion of electron-donor substrate. The results show the possibility to manage peroxidase and oxidase activity of immobilized enzyme.

References

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